

358/199 359/727

REFLECTAR LENSES

WITH

MIRROR OPTICS

40^{INCH}

80^{INCH}

150^{INCH}

THE LIGHTWEIGHT SUPER TELEPHOTO LENSES
FOR MODERN REQUIREMENTS

359/727



ZOOMAR

ZOOMAR INC. • 55 SEACLIFF AVENUE • GLEN COVE,

CRAIG STREET WEST • MONTREAL 1 •



THE REFLECTAR AT WORK

OPTICAL AND MECHANICAL CHARACTERISTICS

REQUIREMENTS FOR A SUPERIOR TELEPHOTO LENS

ZOOMAR^{INC.}

55 SEACLIFF AVENUE

GLEN COVE, L. I., N. Y.

TELEPHONE GLEN COVE 4-6900

GLEN COVE 4-6900 • ZOOMAR (CANADA) LTD. • 265

LONG ISLAND, NEW YORK • TELEPHONE



INTRODUCTION

In the design of modern telephoto lenses, the ideal lens should be a successful combination of extremely long focal length with high picture quality, compactness, and low weight.

The older types of lenses with extremely long focal lengths were merely longer, giant-size versions of standard telephoto lenses. Though they had the required focal length, they were physically unwieldy and the picture quality was poor. They also were difficult to use in infra-red photography because they exhibited a considerable discrepancy between the infra-red and the visible focus which made accurate focusing difficult.

THE REFLECTAR AT WORK
OPTICAL AND MECHANICAL CHARACTERISTICS
REQUIREMENTS FOR A SUPERIOR TELEPHOTO LENS

THE IDEAL SUPER-TELEPHOTO LENS SHOULD HAVE —

1. High Resolving Power
2. High Brilliancy
3. Thermal Stability
4. Full Color Correction
5. Minimum Weight
6. Minimum Length
7. Mechanical Ruggedness
8. Adaptability to all cameras

1. HIGH RESOLVING POWER

Years of research lead to the drastic new design principle of combined mirror and reflecting optics with a potential resolving power approaching the Rayleigh limit. Therefore, the highest resolution physically possible is obtained in the Reflector Lens series. New methods of measuring, testing, and polishing optical glass surfaces assure the highest uniformity of lens performance.

2. HIGH BRILLIANCY

High brilliancy is achieved by an anti-reflection coating on all refracting elements, careful baffling and optical designs with a minimum of geometric aberrations.

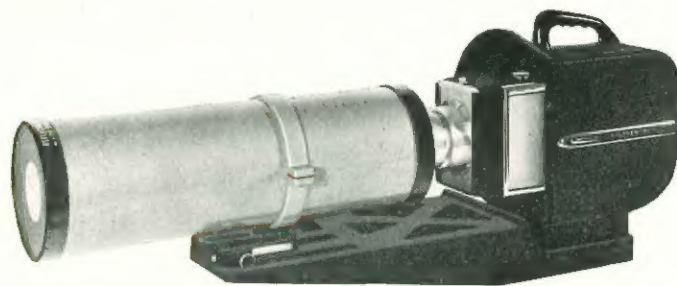
3. THERMAL STABILITY

Thermal stability is extremely important in a lens of this type for two reasons: To prevent image deterioration and to eliminate focus shift.

Image deterioration resulting from temperature changes can be caused by air turbulence within the lens tube or barrel, and by warpage of the optical compounds. Both conditions can exist when a lens is exposed to the hot sun which heats up one side of the lens barrel while the other side remains comparatively cool.

Focus shift on long focal length lenses similarly can be caused by outside temperature changes.

For some time it was thought that if the change in the length of the main lens barrel due to temperature changes could be eliminated there would be no shift in focus. Along this line of thinking, attempts were even made to stabilize the distance between the main mirror cells by using spacer rods made of Invar, a nickel-steel which has negligible thermal expansion. Extensive experiments, however, proved that the influence of temperature changes on focus shift was even greater with Invar-rod stabilization than without it. These experiments revealed that both lenses and mirrors change their curvature at the same rate as their physical dimensions during temperature changes. It was found that even though the distance between the main optical elements was held constant, the radius changes of the mirror surfaces alone caused changes in the focal plane of the image.



80" REFLECTAR F/15
with Hulcher "70" Sequence Camera

Once this fact was evident, the remedy became apparent. If everything with a lens assembly could be made to change at the same rate, focus shift caused by temperature changes could be compensated for.

This is exactly what has been done in the design and construction of the Reflector. The housing of the Reflector is made of a special thermosetting plastic that has practically the same coefficient of expansion as the optical glass used in the optical system. As a result, all optical changes that might be caused by changes in temperature cancel out.

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Also, because plastic has a high thermal insulating quality, the plastic lens barrel prevents the trapped air from heating up when the lens is exposed to the heat of the sun, thus preventing air turbulence which is the main cause of image distortion.

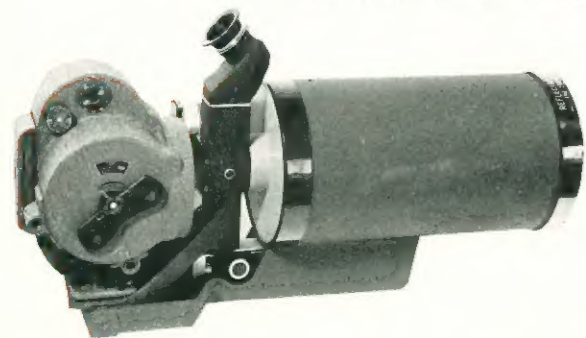
4. FULL COLOR CORRECTION

Mirrors and lenses used in the Reflectar are made with the same painstaking care as the elements in astronomical telescopes. Manufacturing tolerances are held within a fraction of a wavelength. Selected optical glass is used, and all elements and parts are individually matched.

Since the corrector plate of the Reflectar is powerless (a patented feature of the Reflectar), it has no aberration colorwise. Also, since mirrors have no color dispersion, they too are free of color aberration. The special compensator assembly within the lens is computed for the secondary spectrum, and is, therefore, not only achromatic but apochromatic.



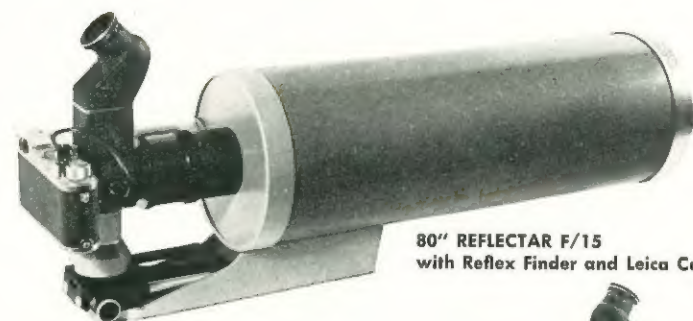
40" REFLECTAR F/8
fitted to Bell & Howell Eyemo with
Extended-Frame-Viewfinder and Reflex-Finder.



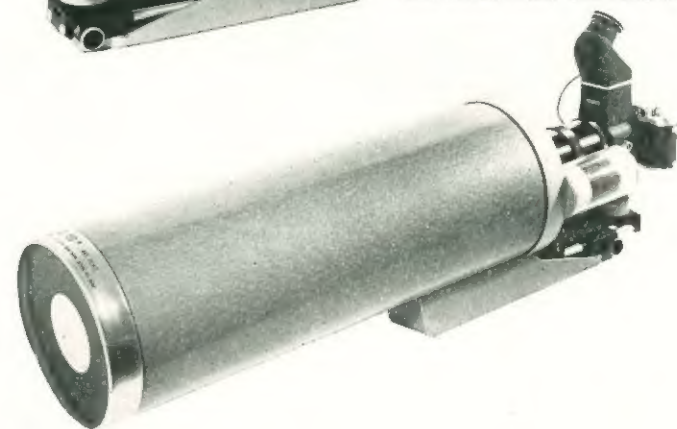
Because of this overall true apochromatic quality, the Reflectar has no noticeable shift in image plane for any of the image-forming wavelengths. As a result, it can be focused without a filter and this focus remains unchanged when a gelatine filter is inserted.

5. MINIMUM WEIGHT

The plastic used in the construction of the Reflectar lens barrel is not only impervious to temperature and humidity, but is extremely light in weight, has high tensile and compressive strengths, and is highly shock resistant. The same type of material has been used in the construction of long-focus TV lenses for a number of years with outstanding results.



80" REFLECTAR F/15
with Reflex Finder and Leica Camera



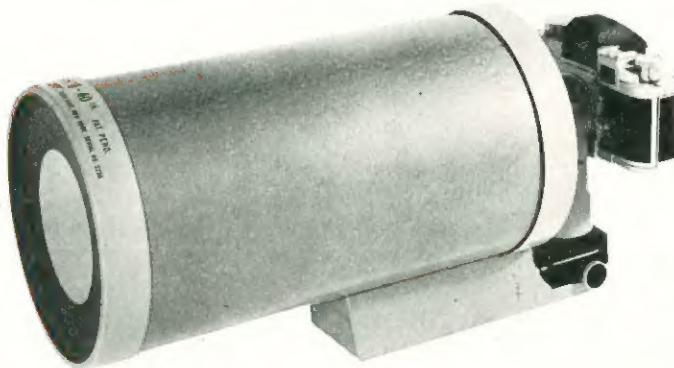
6. MINIMUM LENGTH

Since minimum weight, sturdiness, rigidity, and compactness are more or less contradictory requirements when it comes to practical design and construction, a radically new optical scheme had to be engineered to make short long-focal length lenses practical and usable.

Two of the methods were — folding the light path, and using a combination of refracting and reflecting optical elements. Based on these two, Zoomar has produced three Super-Telephoto Lenses — a 40" Reflector with an overall length (front element to film plane) of 15"; an 80" Reflector with an overall length (front element to film plane) of 25"; and a 150" Reflector with an overall length (front element to film plane) of 29".

7. MECHANICAL RUGGEDNESS

To maintain rigidity and ruggedness and still reduce weight, a new type of mounting had to be devised to replace the heavy brass cells previously used to mount the glass elements. This was achieved by devising a brand new type of plastic cells consisting of a specially developed plastic tape and plastic cement. The new cell holds the lens and mirror elements in place without producing stress and strain. Extensive vibration and thermal tests have proved that this arrangement, unconventional as it may seem, is the best type of construction.



40" REFLECTAR F/8 with Alpha Reflex Camera

8. EASY ADAPTABILITY TO BOTH STILL AND MOTION-PICTURE CAMERAS

Reflector Lenses are designed so they can be adapted easily to either still or motion-picture cameras. What is more, they can be quickly and easily interchanged between them. Also, a wide range of standard filters that are readily available can be used with all Reflector Lenses.

	40" Reflector	80" Reflector	150" Reflector
OPTICAL DATA			
Hyperfocal Distance (Circle of Diffusion 1/1000 inch)	3.156 miles	6.734 miles	14.204 miles
Hyperfocal Distance (Circle of Diffusion 2/1000 inch)	1.578 miles	3.367 miles	7.102 miles
Focal Length	40" (1 meter)	80" (2 meters)	150" (3.75 meters)
Relative Aperture	F/8	F/15	F/25
Maximum Coverage	2½" Dia.	2½" Dia.	3" Dia.
Resolving Power	40 lines per mm on Kodak Plus X Film	40 lines per mm on Kodak Plus X Film	30 lines per mm on Kodak Plus X Film

MECHANICAL DATA

Total Length (Front to Film Plane)	16"	26"	30"
Diameter (outside)	6¼"	6¼"	6¼"
Weight (complete with focusing arrangement and camera adapter)	8½ lbs.	9 lbs.	14 lbs.

PRICE	\$1,500.00	\$2,000.00	\$3,500.00
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The lenses are equipped with lens caps and heavy duty fibre carrying cases. Special supporting brackets, adapters for 35 mm still and motion picture cameras, viewfinders and other accessories are available at additional cost.

REFLECTAR QUALITY

The Reflectar is not an overnight development. It is the result of years of careful research by the same optical experts who developed and perfected the famous Zoomar Lens for motion-picture Photography and television. It embodies a unique combination of optical and structural design to provide the ultimate in long focus lenses.

The experiments leading to the design of the Reflectar started in early 1945. The first Reflectar, designed for television use, made its appearance in 1948. Continuous improvements since that time has brought the Reflectar up to its present stage of perfection.

In production, every lens is individually assembled and tested according to the highest optical standards. Specially designed test equipment, mounted on a 15-ton concrete block to eliminate any possible vibration, was installed at the Zoomar plant to assure foolproof photographic tests. Every Reflectar is subjected to them before it leaves the factory and the results of the tests are made available to the buyer.

REFLECTAR ACCESSORIES

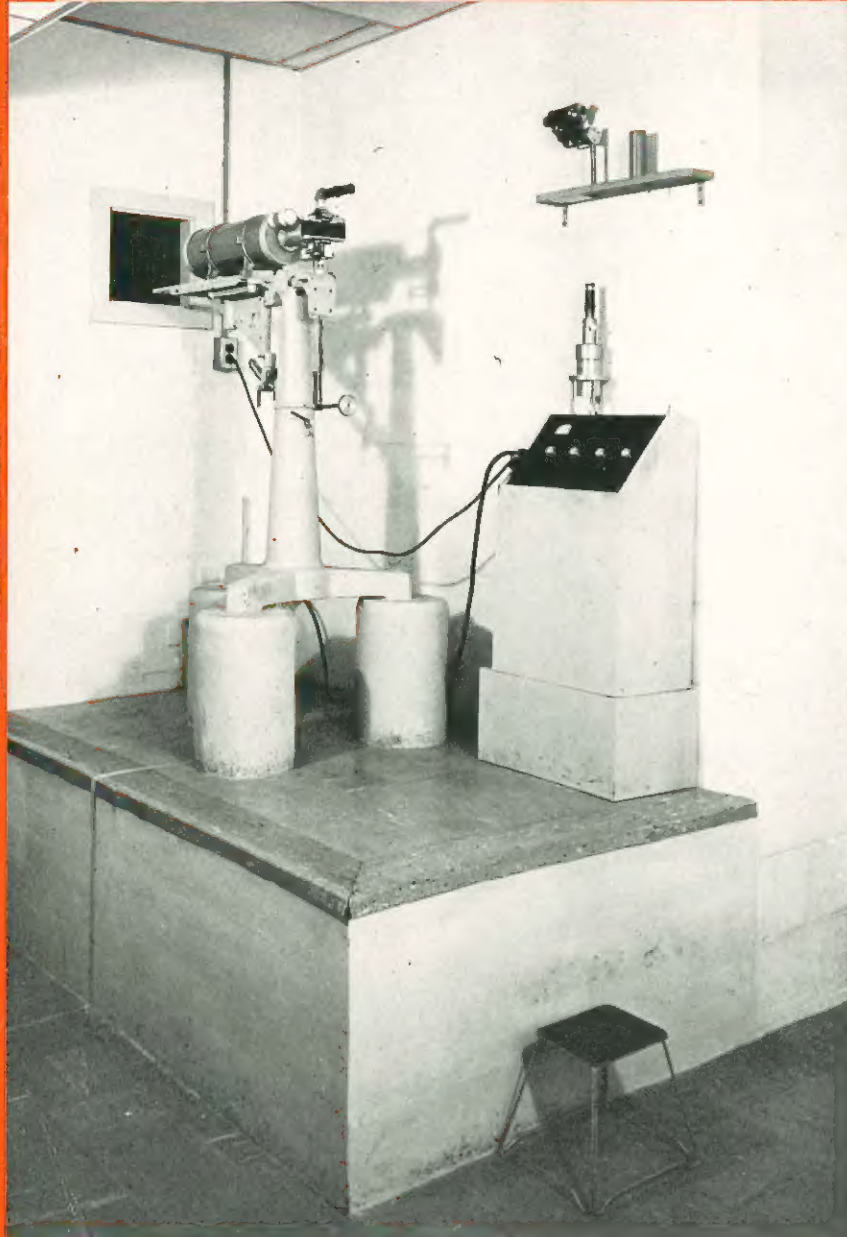
To meet the requirements for adaptability, accessories have been designed around the lenses to fit them to the many uses to which they can be put.

Mirror reflex view finders are available. They can be used on both still and motion-picture cameras and permit the operator to observe and focus the subject until the picture is taken. A sport finder of unique design also is available which enables the cameraman to observe and follow the subject easily. A clear frame (corresponding to the actual frame of the picture) centered in a colored frame which is approximately five times the picture size allows the operator to observe the subject long before it reaches the actual target or picture area outlined by the clear frame.

A prism and mirror arrangement, also available, makes it possible to photograph reticle or fiducial marks at the same time the picture is taken.

REFLECTARS ARE WIDELY USED

Reflectar Lenses, because they do meet the ideal requirements for a super-telephoto lens, are being used successfully in television, news-reel photography, in nature photography, and in many scientific projects — both civilian and military. They are standing up under the hardest usage and under the strictest requirements.



Specially designed test equipment, mounted on a 15-ton concrete block, to eliminate any possible vibration.

Lens: KERN SWITAR 50 mm



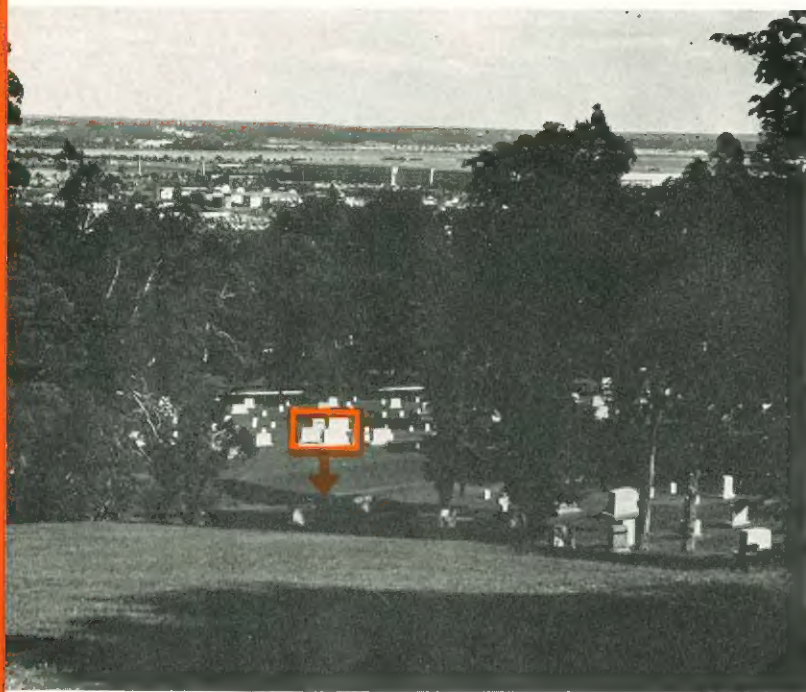
Lens: REFLECTAR 80" F/15



CAMERA LOCATION approximately 2500 feet due East from STATUE OF FREEDOM on top of the United States Capitol Dome in Washington, D. C.

PHOTOGRAPHS
Courtesy of
PHOTOGRAMETRY, Inc.
Silver Spring, Md.

TOMBSTONES IN ARLINGTON NATIONAL CEMETERY
CAMERA LOCATION approximately 2500 feet due West



Lens: SUMMITAR 50 mm

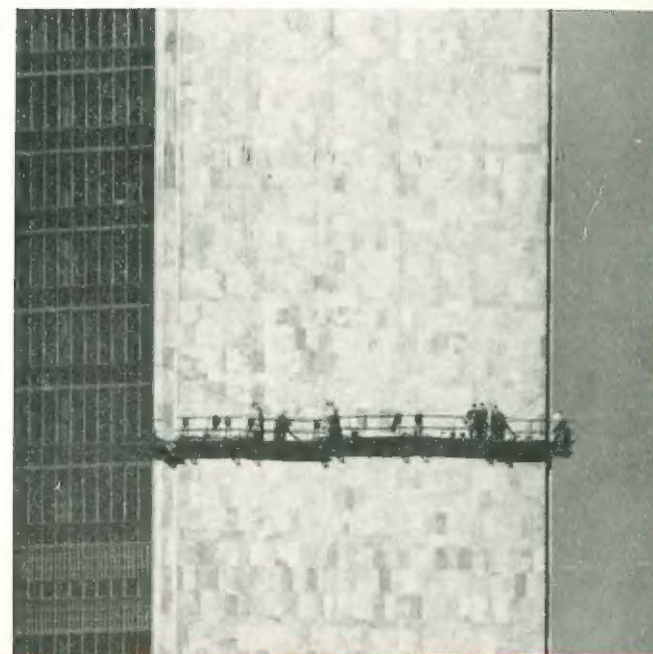


Eastman Kodak Plus X
Lens: 80" REFLECTAR F/15
(Light Yellow Filter)

SCAFFOLDS ON THE UNITED NATIONS BUILDING, New York
CAMERA LOCATION approximately 5000 feet due East



Lens: LEITZ SUMMITAR 50 mm



Lens: 40" REFLECTAR F/8
Eastman Kodak Plus X (Light Yellow Filter)

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OTHER ZOOMAR PRODUCTS

Out of The Zoomar shops and laboratories have come many of the optical industry's "firsts" including:

TELEVISION ZOOMAR

VIDEO REFLECTAR

TV STUDIO ZOOMAR

NEWSREEL ZOOMAR 35

ZOOMAR 16

ZOOMAR 8

ZOOMATARS (Ultra High Speed Lenses) MICROSCOPICAL EQUIPMENT

ZOOMFINDER for U.S. Signal Corps PH 532/US

TRAINING DEVICES for U.S. NAVY

GUN CAMERA OPTICS for JET PLANES

OPTICS for Use in A-BOMB and

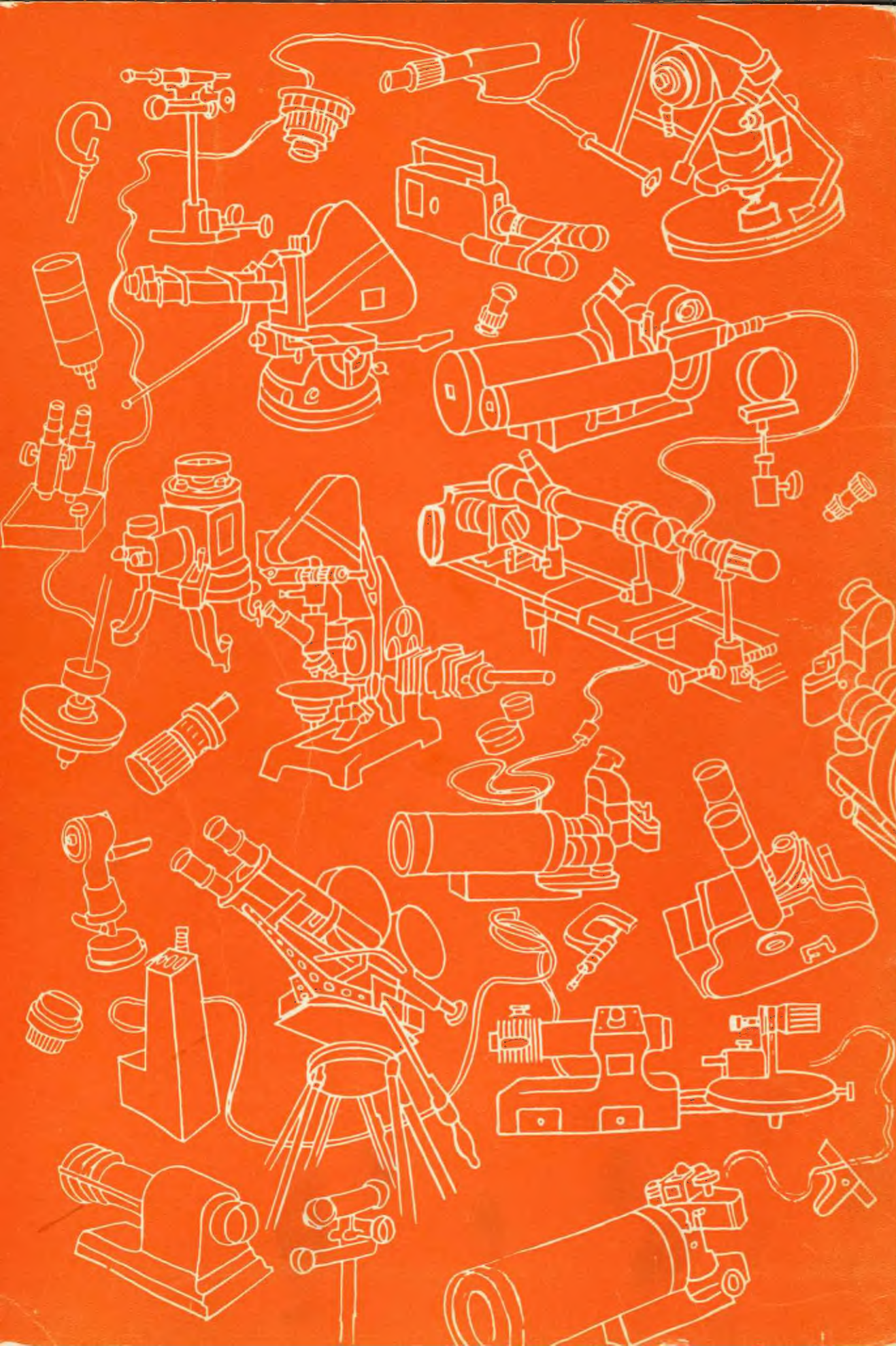
GUIDED MISSILE RESEARCH

OPTICOMETER and T-METER

DESIGNED AND PRINTED BY THE RAM PRESS



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